

MONTHLY WEATHER REVIEW.

Editor: Prof. CLEVELAND ABBE. Assistant Editor: H. H. KIMBALL.

VOL. XXXI.

FEBRUARY, 1903.

No. 2

INTRODUCTION.

The MONTHLY WEATHER REVIEW for February, 1903, is based on data from about 3300 stations, classified as follows:

Weather Bureau stations, regular, telegraph and mail, 160; West Indian service, cable and mail, 8; River and Flood service, rainfall only, 49, river and rainfall, 162; voluntary observers, domestic and foreign, 2565; total Weather Bureau Service, 2944; Canadian Meteorological Service, by telegraph and mail, 20, by mail only, 13; Meteorological Service of the Azores, by cable, 2; Meteorological Office, London, by cable, 8; Mexican Telegraph Company, by cable, 3; Army Post Hospital reports, 18; United States Life-Saving Service, 9; Southern Pacific Company, 96; Hawaiian Meteorological Service, 75; Jamaica Weather Service, 130; Costa Rican Meteorological Service, 25; The New Panama Canal Company, 5; Central Meteorological Observatory of Mexico, 20 station summaries and printed daily bulletins and charts, based on simultaneous observations at about 40 stations; Mexican Federal Telegraph Service, printed daily charts, based on about 30 stations.

Special acknowledgment is made of the hearty cooperation of Prof. R. F. Stupart, Director of the Meteorological Service of the Dominion of Canada; Mr. Curtis J. Lyons, Territorial Meteorologist, Honolulu, H. I.; Señor Manuel E. Pastrana, Director of the Central Meteorological and Magnetic Observatory of Mexico; Camilo A. Gonzales, Director-General of Mexican Telegraphs; Capt. S. I. Kimball, Superintendent of the United States Life-Saving Service; Lieut. Commander W. H. H. Southerland, Hydrographer, United States Navy; H. Pittier, Director of the Physico-Geographic Institute, San José,

Costa Rica; Commandant Francisco S. Chaves, Director of the Meteorological Service of the Azores, Ponta Delgada, St. Michaels, Azores; W. M. Shaw, Esq., Secretary, Meteorological Office, London; Rev. Josef Algué, S. J., Director, Philippine Weather Service; and H. H. Cousins, Chemist, in charge of the Jamaica Weather Office.

Attention is called to the fact that the clocks and self-registers at regular Weather Bureau stations are all set to seventy-fifth meridian or eastern standard time, which is exactly five hours behind Greenwich time; as far as practicable, only this standard of time is used in the text of the REVIEW, since all Weather Bureau observations are required to be taken and recorded by it. The standards used by the public in the United States and Canada and by the voluntary observers are believed to conform generally to the modern international system of standard meridians, one hour apart, beginning with Greenwich. The Hawaiian standard meridian is $157^{\circ} 30'$, or $10^{\text{h}} 30^{\text{m}}$ west of Greenwich. The Costa Rican standard of time is that of San José, $0^{\text{h}} 36^{\text{m}} 13^{\text{s}}$ slower than seventy-fifth meridian time, corresponding to $5^{\text{h}} 36^{\text{m}}$ west of Greenwich. Records of miscellaneous phenomena that are reported occasionally in other standards of time by voluntary observers or newspaper correspondents are sometimes corrected to agree with the eastern standard; otherwise, the local standard is mentioned.

Barometric pressures, whether "station pressures" or "sea-level pressures," are now reduced to standard gravity, so that they express pressure in a standard system of absolute measures.

FORECASTS AND WARNINGS.

By Prof. E. B. GARRIOTT, in charge of Forecast Division.

From February 1 to 17 there was a succession of barometric disturbances of marked intensity over the southern and eastern districts of the United States. These disturbances, four in number, apparently originated over the southern Plateau region at intervals of about four days. From the southern Plateau they moved eastward to Texas, and thence northeastward to the Atlantic coast attended, in three instances, by secondary storms that apparently developed over the west part of the Gulf of Mexico. During this period but one disturbance of marked strength advanced from the Northwest. On the morning of the 9th this disturbance appeared, with barometric pressure below 29.30 inches, in the region north of Washington and western Montana. By the morning of the 10th the northwestern storm, and another from the southern Plateau, had advanced to the one-hundredth meridian. During the 10th the tracks of these storms converged, and by the morning of the 11th they had united over Lake Michigan.

The storms of this period, 1st to 17th, were attended by heavy rain in the southern and heavy snow in the northern districts east of the Pacific coast States, and by high winds on the Atlantic and Gulf coasts and the Great Lakes, and their passage was followed by cold waves of marked severity. In the Ohio Valley and the Southern States the excessive precipitation resulted in high water stages in the rivers and streams.

From the 17th to 24th there was a period of stagnated

weather conditions generally over the United States. From the 23d to the 28th a storm moved from Arizona to the St. Lawrence Valley, its passage over the Great Lakes being attended during the 27th and 28th by storms of marked severity.

Three of the storms referred to, of the first and second decades of the month, and a storm that occupied Newfoundland on the 1st, apparently moved north of east from the American coast and passed to the north of the British Isles, attended over the Atlantic by gales of unusual violence.

A notable feature of the weather of the month was that while the rapid succession of severe storms continued over the United States, the Atlantic, and northern Europe the barometric pressure continued abnormally high over southern, and more especially southwestern Europe; from the 23d, when the center of the last American storm of the month reached the region north of Scotland, until the 28th, barometric pressures were low over southwestern Europe and the center of a barometric depression of exceptional strength remained almost stationary north of the British Isles. The steep barometric gradient of this apparently stationary disturbance extended over the Atlantic almost to the American coast, and caused, during the last five or six days of the month, a continuation of violent gales from Newfoundland to the western European coasts.

The first important storm of the month occupied Nevada on

the morning of the 1st, and reached the Gulf of St. Lawrence on the 5th. The heavy rains of the 3d, 4th, and 5th, accompanied by thawing, resulted in floods in the Allegheny and Monongahela rivers and tributaries. All interests about the headwaters of the Ohio likely to be affected by high water were kept informed by day and night of the stage of the rivers, and advices and warnings were issued hourly by the Pittsburgh office of the Weather Bureau with regard to anticipated stages. On the 4th that office advised the public to prepare for high water, and predicted a stage of 24 feet on the gage at Pittsburgh by the 5th. A stage of 24 feet was reached at noon on the 5th. On the morning of the 5th when the western storm referred to was central over the Canadian Maritime Provinces, the following message was cabled to Lloyds, London:

Severe storm will move eastward from Newfoundland to-day.

This storm reached a position north of the British Isles on the 10th, and by the morning of the 11th had passed over the northern portion of the Scandinavian Peninsula, with central barometric pressure about 28.40 inches.

The second storm of the month appeared on the 6th over New Mexico, to which position it probably advanced from the extreme southern California coast. Moving rapidly eastward this disturbance reached the middle Gulf coast on the morning of the 7th, passed northeastward to Lake Erie by the morning of the 8th, and reached Nova Scotia by the morning of the 9th, with rapidly increasing strength. On the morning of the 7th the following message was telegraphed from Washington to Weather Bureau stations in northern Ohio, western and northern Pennsylvania, and New York:

Heavy snow indicated for to-night in northern Ohio, western Pennsylvania, western and northern New York.

Warning of heavy snow in northern Illinois and northern Indiana was sent from the Weather Bureau office at Chicago.

The snowfall of the 8th was particularly heavy in the central districts of New York, where railroad trains were delayed.

On the morning of the 9th two barometric disturbances appeared, one over New Mexico and the other over the British Northwest Territory. By the morning of the 11th these storms had united over Lake Michigan with a secondary disturbance that appeared on the Texas coast on the morning of the 10th. Moving rapidly eastward the center of disturbance reached the Canadian Maritime Provinces on the 12th, with barometric pressure about 29.00 inches, passed north of the British Isles during the 19th, and reached the extreme northern coast of Norway on the 20th, with central barometric pressure about 28.80 inches.

The severest storm of the month appeared over the southern Plateau on the 12th, and remained nearly stationary over that region until the 15th. By the morning of the 16th the center of disturbance had reached the middle Gulf coast, and another disturbance that occupied the lower Mississippi Valley on the morning of the 15th had moved to the middle Atlantic coast. At 8 a. m. of the 17th the storms referred to had united off the southeast New England coast where the barometric pressure was below 28.90 inches. Passing slowly northeastward the storm center reached a position north of Scotland on the morning of the 23d, with central barometric pressure about 28.60 inches, and the barometer continued very low over that region until the close of the month.

While this storm was gathering over the southern Plateau a severe cold wave appeared in the extreme Northwest. By the morning of the 14th the temperature had fallen to 30° below zero in North Dakota, and the line of zero temperature extended into Minnesota and Nebraska and the central Rocky Mountain region. The movement of the cold wave was retarded by the area of low barometric pressure in the Southwest, but by the morning of the 16th the line of zero tempera-

ture had advanced eastward to the upper Lake region and southward into northern Texas. By the 17th practically the entire country east of the Rocky Mountains was under the influence of the cold wave, the line of zero temperature extending into Kentucky and Tennessee, and that of freezing temperature to the Gulf coast. Killing frost and freezing temperatures occurred in Florida as far south as Tampa, and the minimum temperature at Jacksonville, Fla., was 28°.

The cold wave, heavy snow, and gales that attended this storm were heralded in all districts by ample and timely forecasts and warnings, that permitted railroads and transportation companies in the central and northern districts, vegetable and fruit growers in the south, and shipping interests of the Gulf and Atlantic coasts to adopt precautionary measures. From the 14th to 17th the temperature fell below freezing at many points in southern California. Warning had, however, been given to orange growers.

The following comments were made in connection with the cold wave of the 16th and 17th by the daily press of New Orleans, La.

The Daily States, of February 16, 1903:

Reports received at the Weather Bureau office this morning show that the warnings were as usual timely. The watchfulness of the Weather Bureau, when conditions are threatening, can not be too highly commended, for no severe weather conditions reach this section without timely warning.

The Times-Democrat, of February 18, 1903:

The cold wave brought unseasonably cold weather to the Gulf coast. The temperature fell to 26.7° at New Orleans, 24° at Galveston, and 26° at Corpus Christi, which is almost the exact degrees named in the warnings sent out by the Weather Bureau.

The Picayune, of February 18, 1903:

The severest weather of the winter throughout the Southwest prevailed yesterday morning. Owing to the forecaster's timely notice and warning to planting interests, sugar, truck, and orange growers having been forewarned in ample time, there were taken the proper precautions for the freeze and severe injury was averted. This forecast having been implicitly believed by the agriculturists of the district, who had occasion last year to rely on Dr. Cline's accurate prediction, saved them many hundreds of thousands of dollars. When it is considered that such low temperatures do not occur in February more than once in eight or ten years, the successful forecasting thereof, in every instance of their occurrence, speaks much for the skill and efficiency of the Weather Bureau forecaster.

The following letter, dated February 21, 1903, was received by the Weather Bureau observer at San Antonio, Tex., from the president of the San Jose Truck Farm Company:

The daily weather forecasts, and particularly the cold wave warnings of the recent cold snap, have been of inestimable value to us. It was only through careful attention to the forecasts from the Weather Bureau and promptly acting on the warnings that we have managed to bring through, without loss of a plant, our crop of 35 acres of tomatoes.

Gales of unusual severity prevailed on the north Atlantic coast of the United States during the 16th and 17th and in New England snow fell to a depth of 15 to 20 inches.

The Boston Globe, of February 18, commented as follows regarding this storm:

The biggest storm that Boston has seen for at least five years ceased yesterday, although its effects will be felt for several days yet. The storm was heralded by the Weather Bureau Sunday night. This gave sea captains more than eighteen hours notice and doubtless saved many vessels and lives.

The other Boston papers also made favorable mention of the storm warnings and forecasts.

The next and last important storm of the month advanced from Arizona to the middle coast of the Gulf of Mexico from the 23d to the 27th, and, moving thence northeastward, united by the morning of the 28th with a storm that appeared over the middle Missouri Valley on the morning of the 27th, and moved thence over the upper Lake region by the morning of the 28th, with central barometric pressure about 29.15 inches.

Beginning on the 24th snow fell in the interior of the southwestern districts. The snowfall was unusually heavy in northern New Mexico, southeastern Colorado, Indian Territory, and portions of western Texas. At Amarillo, in the Texas panhandle, a total fall of 20 inches was reported. The snowstorm was followed by a cold wave of two days duration in the Southwest, with a minimum temperature of 10° at Amarillo.

The heavy rains that attended the passage of this storm caused rapid rises in the rivers of the Southern States and the Ohio Valley, in anticipation of which general flood warnings had been issued.

BOSTON FORECAST DISTRICT.

Heavy thunderstorms, a cold wave, a thaw, a heavy snowstorm, and gales of hurricane force occurred during the month. The most severe storm of the month was that of the 16-17th, when from 15 to 20 inches of snow fell over the district and gales of great force prevailed along the coast. Owing to the excellent work of the Weather Bureau, little if any damage resulted to shipping. The Bureau was highly commended by the press for giving timely warnings of the storm, thereby saving life and property.—*J. W. Smith, Forecast Official.*

NEW ORLEANS FORECAST DISTRICT.

Storms occurred along the Gulf coast on the 11th, 16th, and 26th, for which timely warnings were issued. At 1 p. m. on the 15th, when the barometer was falling over southeast Texas, Louisiana, and western Mississippi, cold-wave warnings were ordered for Arkansas, northern Louisiana, and southern Texas. The cold-wave warnings were extended to southern Louisiana at night. Reports at 8 a. m. of the 16th showed freezing temperature to the Texas coast and indicated the severest weather of the winter so far, and warnings were sent out that the temperature would fall to 20° in the sugar region and to 24° to 26° along the Gulf coast. On Wednesday morning the temperature was about 24° to 26° along the Gulf coast and 20° in the sugar region. Seed cane and other products were protected generally.—*I. M. Cline, Forecast Official.*

CHICAGO FORECAST DISTRICT.

The cold wave of most importance during the month developed over the British Northwest on the 12th. However, it remained over the Northwestern States without decided movement until the 15th. During the 15th and 16th it extended over the eastern and southern portions of the district. The movement of this cold wave was so tardy and irregular, causing gradually falling temperatures at many points, that warnings were issued only in the eastern and northwestern portions of the district, in advance of a moderate cold wave which was approaching from the Northwest. Three severe storms crossed the district during the month, which were attended by high winds and heavy snow north of their tracks. The first appeared in the Southwest at the beginning of the month; it moved eastward and northeastward toward the Lake region, accompanied by heavy rain, snow, and sleet, reaching the latter section on the 3d and 4th. The second storm was first noticed February 5 on the southern California coast. It followed nearly the track of its predecessor and crossed the southern Lake region on the 7th and 8th. The third also moved from the Southwest. It first crossed eastward to the lower Mississippi Valley, reached the Lake region February 14 and 15, and was followed by a cold wave. Warnings were issued to all railroads and transportation companies in advance of these heavy snowstorms, and, although traffic was maintained only with great difficulty, the advance warnings pre-

pared the various interests for the emergency, and rendered them valuable assistance.

Warnings were issued during the month from time to time to all open ports on Lake Michigan in advance of approaching storms. Vessel interests were especially advised of the dangerous storms of the 3d-4th, 7-8th, 14-15th, and 28th. These four storms were exceptionally severe, but no casualties of any kind were reported.—*H. J. Cor, Professor.*

DENVER FORECAST DISTRICT.

As a result of southwestern storms unusually cold weather was a feature throughout the district, especially in the northern part. In Colorado the month was not only the coldest February but also the coldest month in fifteen years. In anticipation of the development of a disturbance in the middle Plateau region, snow and decidedly lower temperatures were forecast on the morning of the 11th for the northern half of the district, and warnings of a cold wave were issued for Wyoming. The snowfall in northern Utah was very heavy. On the following morning warnings of the approach of severe cold weather were sent to southern Utah and western Colorado. Hemmed in by the Continental Divide and the additional barrier of a high area, reenforced from time to time, on the eastern slope, the low area remained practically stationary in northern Arizona until the afternoon of the 15th, a distribution of pressure that gave uninterrupted and abnormally cold weather in Utah, Wyoming, and Colorado until early in the morning of the 16th, when a depression began to develop in southeastern Wyoming. This low was attended by high winds in Wyoming and northeastern Colorado, uncovering the grass for range stock, and at the same time drifting the unpacked snow into railroad cuts. On many lines it was several days before it was possible to resume traffic. The fair and comparatively fine weather of the succeeding week was exceedingly fortunate for range stock which had been suffering severely from the cold and lack of feed, but where it was possible to heed the warnings by gathering and feeding no losses were incurred. Snow in southeastern Colorado and New Mexico was forecast for several days beginning with the 23d. The snow fall was unusually heavy in northern New Mexico and throughout southeastern Colorado.—*F. H. Brandenburg, Forecast Official.*

SAN FRANCISCO FORECAST DISTRICT.

The month was an unusually quiet one, as February is generally a stormy month on this coast. Generous rains prevailed at the beginning of the month over the southern and central portions of the State, with heavy snow in the mountains. Heavy frosts in southern California on February 3 were accurately forecast. Southeast storm warnings from San Francisco on February 3 were verified. Generous rains prevailed on February 4 in southern California and frost warnings were again verified. Southeast storm warnings were displayed along the coast on February 7 and were verified north of Point Conception. At Point Reyes the wind reached a velocity of 74 miles per hour from the southeast. Beginning about February 10 a succession of high areas prevailed over northern California and northern Nevada. A depression of moderate depth remained over Arizona and the valley of the Colorado for several days. Killing frosts occurred generally north of the Tehachapi on February 14, 15, 16, and 17 and temperatures below freezing were reported at many points in the citrus fruit belt of southern California. Ample warning of these frosts was given to the orange growers and extensive smudging was pursued. During the last decade of the month the weather was fair and pleasant with the exception of the 22d, when a small